CONCERNING COLOR THEORIES AND THE GENERAL HARMONY OF COLOR.

BY GEORGE CURTIS WRIGHT.

THE theory of Thomas Young, as elaborated and promulgated by Professor Helmholtz, through whose reasoning and experiments it was raised to the dignity and assurance it now assumes, has, until quite recently, been the one most relied upon in explanation of colored vision. It is yet to be proved that it is anything more than a pure hypothesis, since not one of its fundamental principles is a demonstrated or demonstrable fact.

Professor Young's vivid imagination seizes upon the hypothesis which seemed to satisfy the demands of an acceptable theory, as it appeared to account for nearly all of the observed phenomena. When Helmholtz revivified and resurrected this theory, the question of color blindness had not been investigated to the extent it has within the past ten years, and most physicists rested content, believing the true theory of colors had been discovered at last.

Undoubtedly the true theory of vision is one of the questions to be solved by the coming physiologist. It seems very simple and plausible in considering the Young-Helmholtz theory, demanding as it does three primary or fundamental colors (by the admixture of which all other colors are produced), but certain phenomena of vision renders it necessary to modify this simplicity, and practically mar its symmetry, giving it an elasticity which is not agreeable to the student of exact science. The phenomena of color blindness is explained in keeping with this theory, but in not altogether a plausible manner. In accordance with this theory, there can be no color-blindness in the true acceptance of the term except when all color fibres are lacking, because all colors produce an impression of some kind, though it may not be the one experienced in those of normal color perception. There is, moreover, a marked confusion of the various colors, and by the special character of this confusion one kind of color-blindness is differential from another. It is made quite plain by deductive reasoning and experiments on the color blind (upon whom much depends in color research) that the evidences are against the three fibre theory of Young-Helmholtz, inasmuch that the red-blind can not distinguish perfectly the greens and violets, nor the green-blind the reds and violets, yellow and blue being the only colors about which they make no mistake. Even in a spectrum, which is very much shortened, the red-blind finds the brightest place, not in the bluish-green, as we would expect, but in the yellow, as in the normal eye. This theory does not explain satisfactorily the extreme shortening of the spectrum entering, as it sometimes does, into orange, and even into yellow. The line of demarcation in the spectrum is sharply at the blue, all to the left almost always appearing of one color, and all to the right of another, there being no lines of division between blue and violet, nor between the red and yellow and the yellow and green. The gray or neutral band is far from being invariably present, and when it is it is often, in the red-blind, in the position it should be in the green-blind. There is another theory of colors brought forward within the last few years by Professor Hering, of Prague, which is sustained by many physiologists, and is a vigorous rival of the Young-Helmholtz theory. It is quite different from that of Young, and assumes that the retina is provided with three visual substances, and the fundamental sensations are not three, but six, which are called the black-white, the red-green, and the blue-yellow. Light acts upon these substances by what Hering terms assimilation (A) and dissimilation (D), thus red light acts on the red-green substance in exactly the opposite way from green light, and when both kinds of light are present in suitable proportions a balance is effected, and both sensations, red and green, vanish. Hering is not certain which are the A and which the D colors, but he is disposed to regard red as the dissimilating color of the red-green substance, and green the assimilating color. Blue, he thinks, causes dissimilation of the blue-yellow substance, while its regeneration is caused by yellow. All colors, he supposes, act in a dissimilating manner on the black-white substance—that is, they produce the sensation of white in addition to their own peculiar color. In accordance with this theory there are, therefore, four fundamental colors instead of three (excluding black and white), namely, red, green, yellow and blue, and they are supposed to be produced in the following manner: Red is the product of dissimilation of the red-green substance, green is the result of its assimilation; blue is the result of the dissimilation of the blue-yellow, and yellow of its assimilation. When the A and D action on the red-green and blue-yellow substance are equal, there is no color sensation, but only a D action of these colors on the black-white substance, which is white. Simultaneous A and D action on the black-white substance, however, is not attended by abolition of sensation, but by the sensation of gray. In the Hering theory, what were formerly considered as complementary colors are antagonistic, and tend to neutralize each other. Those colors have been called complementary (when considering the colored rays of the spectrum) which when mixed together, would produce white light. This was accounted for by the Young-Helmholtz theory on the principle of subtraction. From the foregoing, it is evident that neither of the two theories satisfactorily accounts for all the phenomena of color sensations.

COLUMN IN ENTRANCE COURT OF THE PALAZZO VECCHIO, FLORENCE.

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When the true theory of colors is found, it will undoubtedly be very simple, and the laws governing the sense of vision may bear some analogy to those controlling the other senses; possibly in the direction pointed out by the recent researches on the physical reaction of certain simple substances to the undulations of the luminiferous ether. This reaction may be chemical, purely physical, or chemico-physical. The changes in the molecular structure of simple substances, caused by the action of ether or the variation in the sensation produced will have its basis, not in the complexity of tissue, but in the varying action of the affecting agent. The acceptance of such an hypothesis does not necessarily involve the invention of new laws, or of creating new issues; it simply applies known laws and analogous reactions of other substances to the explanation of the phenomena observed.

These are membranes which respond with promptness to any number of simple aerial vibrations at the same time, recent discoveries proving that when certain substances are in proper condition they respond to wave-lengths of light.

When in a chrystaline condition, silenium alters its molecular construction (as manifested by its varying resistance to the passage of the electric current) not only when acted on by light of varying intensity, but also by different wave-lengths.

Suppose the retina to be a substance of this nature, but responding more promptly, and in a more delicate manner than any other known substance to the wave-lengths of light, we have the keystone of another theory of vision extremely simple, and based on known physical laws.

The changes produced by these wave-lengths of light upon the molecular structure of the retina would be transmitted by the optic nerve to the centre of vision in the brain, and there converted into a sensation.

The difference in the various theories of color lies in the supposed reaction of the retina to light. After the impression has passed beyond this line, there is no special difference in the views as to the final conversion into a sensation.

It is safe to assume, with our knowledge of analogous matters, that the perfect discernment of colors is a power partly inherited and partly developed in the individual, we should, therefore, expect to find this power, which is undoubtedly cerebral in its character, most strongly developed where the faculty was most used. Women, who are much more concerned than men in the selection and comparison of colors, are rarely affected with color blindness. The feminine eye is much quicker in detecting slight differences in shades of color than is that of men. It may be a question of years ere the true solution of color sensations is definitely determined. However, with our present knowledge, an apparently plausible combination is effected in the harmonious use of color based on the Young-Helmholtz theory. It certainly overthrows all the reasonings of those who sustain Brewster's theory of there being only *three fundamental kinds* of light, red, yellow, and blue (though it is the one believed in by most artists). As previously mentioned, the study of color blindness has furnished evidence in favor of the choice of Young, and its phenomena seem explicable by it.

THE PALAZZO VECCHIO, FLORENCE.

To one familiar with the history of Florence, a study of the court of this Palace must be of interest, for it was the scene of some of the most thrilling events connected with that Republic. Built by Arnolfo del Cambio, the architect of the Church of Santa Croce, it served for years as the residence of the chief magistrates of the city during their exceedingly brief term of office of two months. When the Republic was declared at an end the Palace was occupied by Cosimo I., and since that time it has been devoted to the business purposes of the government.

The building in its architecture is massive and stately, beauty has been sacrificed to the strength, and it gives one the impression more of a fortress or a prison than the dwelling of a king. The interior however fully compensates for the almost forbidding aspect of the outer walls. The court, of which we give an illustration together with a column enlarged in detail all from our contemporary *Art and Letters*, constituted the approach to the inner apartments, and is adorned with frescos, many of them badly faded, representing scenes in German cities, and on the columns the most elaborate and richest patterns of the Renaissance. In the centre of this court is a fountain of a boy and dolphin designed by Andrea del Verocchio for Lorenzo de Medici.

At the head of the grand stairway, is the Great Saloon, or the Sala del Cinquecento, the most interesting place in the building, and in size seventy-five feet by one hundred and seventy. The ceiling is most gorgeously decorated in the floriated and grotesque styles, in the most vivid and exciting colors, the walls have remnants of a fresco by Michel Angelo, representing the soldiers of Florence surprised by the enemy whilst bathing; and the unfortunate evidences of a fresco by Leonardo de Vinci, which, owing to the poverty of the materials used, crumbled away until nothing but a suspicion of it is left. The remaining frescos, of which there are many, are almost entirely historical incidents, and by Nasari, Ligozzi, Cigoli and Passignano. The interest attached to this room is almost entirely of a historical character, and recalls the addresses made here by Savonarola and Victor Emmanuel.

The audience chamber in the Palace has also many very good features, among them being a finely